A MILK BORNE EPIDEMIC OF TYPHOID FEVER TRACED TO A URINARY CARRIER

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THE outbreak here recorded occurred in Portland, Oregon, in the spring of 1924, and consisted of twenty-six cases with five deaths. All of the cases were found to be customers of a single dairy delivering raw milk, and it was subsequently determined that a milker at this dairy was excreting typhoid bacteria in large numbers in his urine. The detailed results of an investigation of the outbreak are given below.

Portland is a city of about 300,000 inhabitants. The water supply has its origin in the drainage from an inacessible watershed, and is delivered without any treatment whatever except storage for short periods in reservoirs beyond the reach of human contamination. No epidemic has ever been traced to the Portland water; nor has it ever been under suspicion as the carrier of infection. The milk supply of the city is furnished by an exceptionally large number of small dairies. About 60 per cent of the total supply is pasteurized, the rest being delivered from about 180 independent raw milk dairies.

The city has the reputation of having a very low typhoid morbidity rate. The Health Bureau records show that from December 1, 1923, to March 4, 1924, not a single case of typhoid was reported as originating in the city.

On March 4 the first case was reported in the person of a railroad worker who had had many opportunities for acquiring the infection. Following this there were reported one case each on March 6 and 7, three cases on March 10 and one each on March 15 and 19. In accordance with routine, epidemiological data was secured from each case.

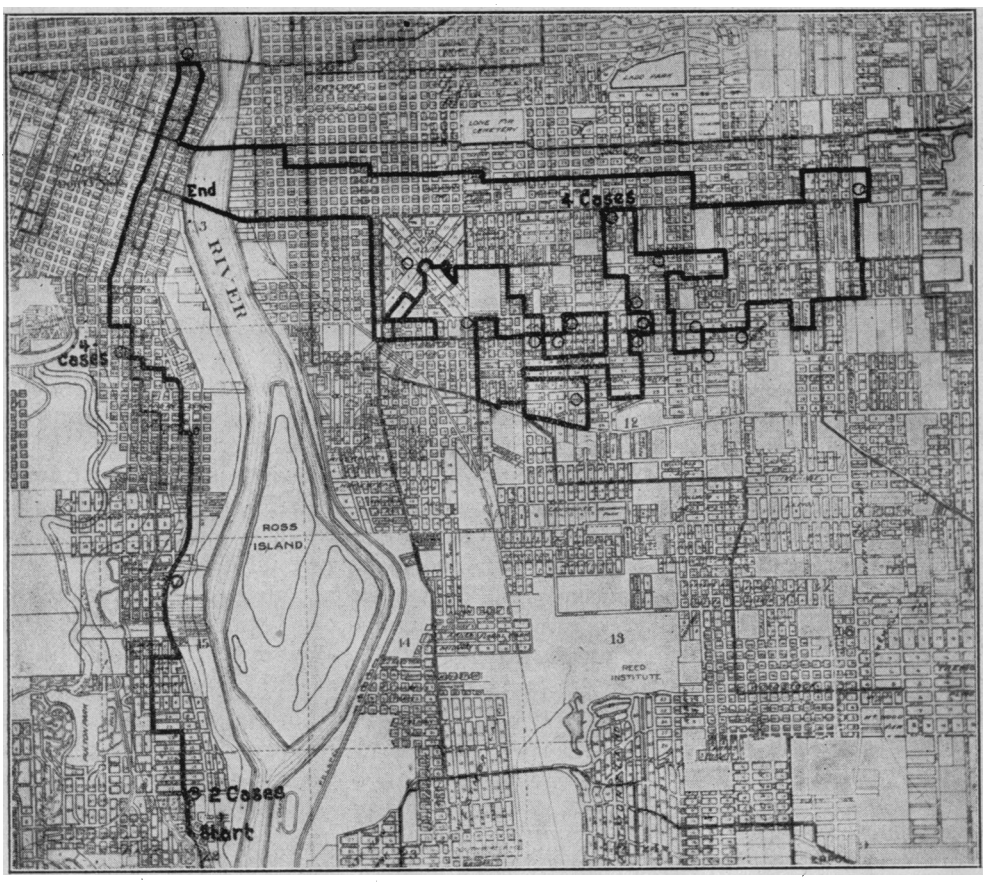
An inspection of this data showed that all of the eight cases reported were in families taking milk from the R. H. dairy. This dairy, located about 3 miles south of the city, consists of a herd of about 80 cows, owned and operated by A. W. B. and his son O. B., who with the latter's wife and year old child lived in the ranch house on the premises. Three additional men also living at the ranch house were employed at the dairy chiefly as milkers.

At the time of the first investigation it was stated by the owners that all of the men had been with them for more than a year, and that no others had been employed during that time. None of the seven persons at the ranch gave any history of a recent illness and all denied ever having had typhoid fever.

There was an open toilet at the dairy, but the time of year precluded the transfer of the infection by flies. Water was obtained from two sources, the regular city supply, and a spring on the premises. The latter was said not to be used but was available from faucets in the milk house. Samples from both sources showed B. coli to be absent. The epidemic seemed explainable only on the supposition that one of the employes at the dairy was a carrier.

On March 21 the laboratory of bacteriology of the Medical School was called and requested to assist in tracing the source of the outbreak and on March 22 stool specimens were collected from each of the five men at the dairy and examined for typhoid bacilli. All were reported negative.

On March 28, new cases having been reported in the meantime, City Health Officer Parrish ordered the owner to



Map of Portland showing relation of cases to milk route.

deliver no more milk from the dairy unless pasteurized. This order was complied with the next day, the pasteurization being carried out in one of the established plants in the city.

Some confusion was injected into the early part of the investigation by the fact that several of the cases were diagnosed by laboratories in the city as paratyphoid A, and in one or two as paratyphoid B on the basis of Widal reactions. One or two blood cultures, on the other hand, had been reported as positive for typhoid. It became necessary, therefore, to test the correctness of these diagnoses to determine whether we were dealing with a mixed epidemic. We did this by examining, on March 29 and 30 and April 1, specimens of stools and urine from eleven of the patients. A number of these were already in the convalescent stage, but we succeeded in isolating and identifying the typhoid bacillus in five cases, while the paratyphoid bacilli were not met with once. These results and subsequent reports from various laboratories of the finding of B. typhosus in blood, stools and urine of patients, definitely ruled out any admixture of paratyphoid in the outbreak.

On March 29 we again received specimens from the dairy workers, this time both stools and urine. Specimens from Mrs. B. and her baby were included also in this collection. The results were again negative. On examination of the names on the specimens, however, it was observed that one of the men previously cultured was missing. An investigation showed that a milker,

W. K., had left the dairy on March 23 and a new man had taken his place. W. K. was sought out and returned to the premises on March 30.

On April 1, stool and urine specimens were again collected from the dairy, W. K. being included. These specimens were obtained late in the evening and kept in the ice box over night. A number of suspicious colonies were fished from the Endo's plates but all proved negative when subjected to the usual cultural and serological tests.

On April 8, another series of specimens was collected. In the examination of this fourth series it was observed that the Endo's plate upon which a loopful of the urine of W. K. had been streaked, appeared to contain a pure culture of a non-lactose fermenting organism resembling B. typhosus. The organism was a Gram negative rod, but proved to be very sluggishly motile, in this respect resembling B. coli more than B. typhosus. Furthermore with a fairly potent antityphoid rabbit serum no agglutination occurred. The organism gave the fermentation reaction of B. typhosus, though on Russell's medium it showed a tendency to give a slight acidification on the upper part of the slope as well as in the butt of the tube.

Organisms of this sort are not infrequently met with in normal stool cultures; so we believed there was little chance that this one would prove to be B. typhosus. It was felt advisable to test it further, however, and after the growth of four or five generations on plain agar its agglutinating properties were tested again with an antityphoid serum.

Absolutely no evidence of agglutination appeared after two hours in the water bath; but after the tubes had remained all night in the icebox we were much surprised to observe very definite agglutination in all dilutions up to 1-6400. This same serum gave an agglutination of a stock laboratory culture of B. typhosus in a dilution of 1-8000. In the latter case, however, the reaction was complete after two hours in the water bath at 40° C.

Subsequent confirmation of the diagnosis on the organisms from W. K. was made by inoculating rabbits with it and also with a strain isolated from one of the patients. The serum from the animal immunized with the carrier strain agglutinated this strain in dilutions up to 1-2500, the strain from the patient in dilutions up to 1-1200, and a stock laboratory strain in dilutions up to 1-5000. The serum from the animal immunized with the patient's strain agglutinated the carrier strain in a 1-1200 dilution, its own homologous strain in a dilution of 1-2500 and the laboratory stock culture in a dilution of 1-5000. The carrier strain, even with its homologous serum, always showed late agglutination, no evidence of a reaction being observable after two hours in the water bath at 40° C.

The serum of the carrier, W. K., agglutinated his own organisms in a dilution of 1-160, those from two patients in dilutions of 1-160 and 1-320 respectively, and the stock typhoid culture in a dilution of 1-320. The serum from a patient agglutinated the carrier strain in a dilution of 1-80.

A diagnosis of the carrier condition having been made, W. K. was removed from the dairy and brought to the Multnomah Hospital adjacent to the Medical School laboratories where he remained under observation until June 9, a period of seven weeks. Numerous examinations of his stools and urine were made during this time. The former were regularly negative, the latter consistently positive. A more detailed study of this carrier is given below.

THE EPIDEMIC

The accompanying map shows the location of cases in the city in their relation to the milk route. The report of the first case came to the Health Bureau in the form of a death certificate upon which the cause of death was given as

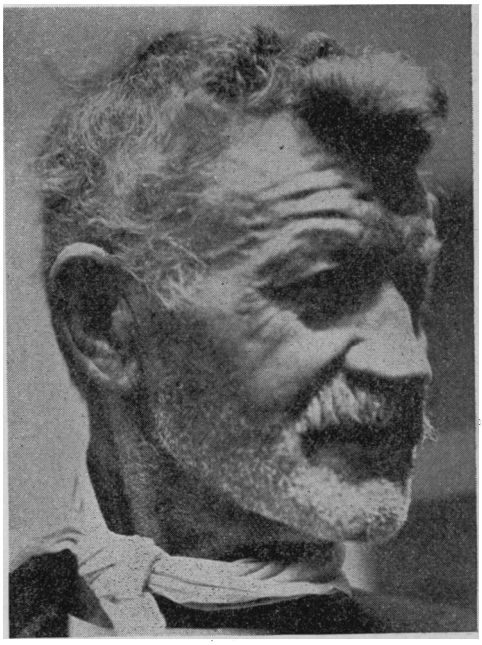
intestinal hemorrhage. It was learned later, however, that one of the physicians on the case had favored the diagnosis of typhoid. This person had taken milk from the R. H. dairy.

Two other cases were diagnosed as typhoid by clinical methods only. All the others were confirmed by laboratory tests. All the cases are known to have taken milk from the R. H. dairy except one, who lived at a hotel across the street from the one restaurant supplied with milk by this dairy.

Milk epidemics of typhoid are generally described as explosive in character. Such was not the case in this instance. The largest number of cases coming down in one day was three, and the rule was only one per day. Several periods of from five to ten days in length intervened when no new cases occurred. Except for the well-known variability in the length of the incubation period in typhoid, this might suggest intermittency in the infectiousness of the milk.

The dairyman's records show that at the beginning of the epidemic he was distributing a total of 396 quarts of milk daily. Among his customers were one hundred and seventy-five private families, one apartment house, one restaurant and four grocery stores. The latter sold the milk to their customers in the original bottles. Assuming a pint per day for each person, it may be estimated that about eight hundred people were drinking the milk from this dairy. It was the custom of the dairy to cool and bottle the milk immediately after milking. The bottles were kept cool in a vat of ice water until loaded for delivery. The route being short, only a few hours intervened between the milking and the time of delivery.

A possible explanation of the low incidence of typhoid among consumers, therefore, might be found in the assumption that cases occurred especially where the keeping time and the temperature in the home favored multiplication of the organisms. Against this supposition is the fact that in the majority of affected homes only one case occurred. Exceptions were a home in which four people, a mother and three children, were infected, an apartment house with four patients and another home with two. As in most milk epidemics of typhoid there occurred a higher incidence among



The carrier.

women and children than among adult men. The case mortality of 18 per cent is higher than is generally experienced in milk borne typhoid.

A few interesting deductions regarding the incubation period of typhoid are brought out in this investigation. The last raw milk from this dairy was delivered on March 28; thereafter pasteurization was carried out under conditions that we believe rule out the probability of any infection being transmitted in the milk. However, three cases had their onset about April 20, and one case as late as April 24. These cases all occurred among users of R. H. milk, and in families not previously attacked. There was nothing in the history of the cases

that pointed to contact infection from previous cases; so that it appears that they originated directly from the infected milk. If so, incubation periods of at least twenty-two and twenty-seven days respectively are indicated.

The time relationship between the arrival of the carrier at the dairy and the appearance of the first case is difficult to explain. The statement of the owner that all employees had been with him for a year was found on inquiry to be incorrect. The carrier, W. K., had begun work on December 8, 1923, and had worked continuously at the dairy from that time, chiefly as a milker. If we accept February 18 as the date of onset of the first case (the date given by the patient) we have an interval of about ten weeks between the first possible infection of the milk and the outbreak of the disease. The time of the year would, of course, decrease the probability of rapid multiplication of the organisms, while a part of the delay may be due to the organism having an unusually long incubation period.

THE CARRIER

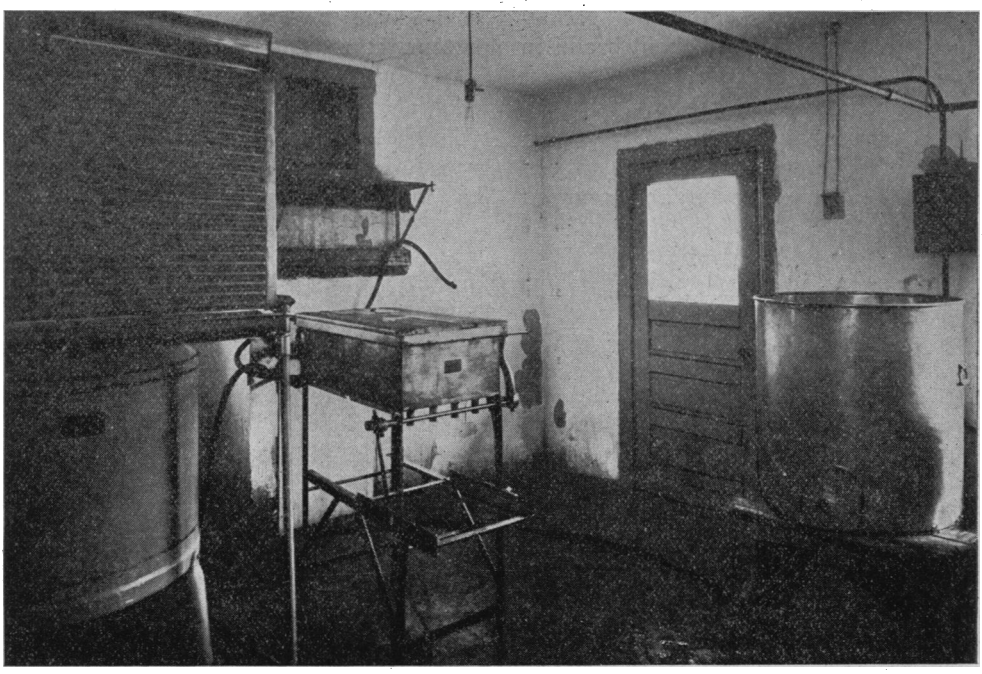
The carrier, W. K., is a Swiss by birth, seventy-two years of age, and has the appearance of being in excellent health. Except for a period of a year in San Francisco, he has lived in Oregon for 52 years. Just previous to his arrival at the R. H. dairy he had been living in central Oregon on a wheat ranch for about 12 years. During all the rest of the 52 years he has been engaged in the dairy business in and about Portland. His history was entirely negative with respect to typhoid; in fact, he stoutly maintained that he had never been sick in his life except for an occasional cold.

The very incomplete information that could be gathered about his associations previous to going to the ranch in central Oregon in 1912, gave no indication of his ever having been related to any typhoid cases. He himself could not recall ever having heard of a typhoid epidemic in his neighborhood, and no dairy with which he had been connected had ever been under suspicion as the source of typhoid infection. It seems likely that his infection must have occurred at some time during the period between 1912 and December, 1923, while he was not in any way associated with the handling of milk, and that the present outbreak is the only one for which he is responsible. This is by no means proved.

After W. K. was brought to the hospital on April 18, he was placed in sanitary isolation under the care of the urological staff. Samples of urine were examined daily for ten days and at intervals of a few days thereafter. Every sample showed very large numbers of typhoid bacilli. Total counts were made on a number of samples and figures varying from 500,000 to 10,000,000 per c.c. were obtained. The majority of specimens gave the higher figure. A microscopic and chemical examination of the urine showed a large amount of pus, a few hyaline casts, no sugar, and only a trace of albumin, the pH was generally about 6.4.

A detailed clinical report of the case will be published elsewhere by Dr. H. W. Howard who made the study; but it should be stated that the focus of infection seems to have been quite definitely located in the seminal vesicles. The vesicles were much swollen and the fluid expressed by massage showed many pus cells and a pure culture of typhoid bacilli. The prostate was normal, and cystoscopy showed both kidneys free from infection. Repeated massage of the vesicles reduced them to normal size and the very small amount of fluid expressed on the last occasion was sterile.

On May 13, treatment with urotropin was started, salol coated tablets being given twice daily together with sodium acid phosphate to insure an acid urine. The effect of this drug was at once evident in the reduction in the number of organisms excreted. Total counts after this treatment was started varied



Interior of milk house showing mixing vat, bottler and cooler. The pasteurizer in the lower left hand corner was installed after the outbreak.

from 5,000 to 50,000 per c.c. Not a single specimen, however, failed to show some typhoid bacilli. On June 2, five days preceding his release from quarantine, a single loopful of the urine plated on Endo's agar gave numerous colonies identified by specific agglutination as B. typhosus.

It is obvious that this man is still a carrier. He was released under orders never again to engage in the handling of foods for human consumption. During his period of quarantine he came to the laboratory frequently and an attempt was made, with ill success, to impress upon him the seriousness of his condition, and to educate him in the means of preventing any further dissemination of typhoid infection. He entirely failed, or refused, to comprehend the danger, and when this is taken into consideration, together with the fact that for more than fifty years he has earned his living chiefly by milking cows and knows little of other forms of labor, it must be expected that the closest surveillance will be necessary to make certain that he does not again engage in this occupation.

SUMMARY

The main facts brought out about the epidemic in the foregoing study are as follows:

Twenty-six cases of typhoid fever with five deaths resulted from the drinking of the unpasteurized milk of a dairy serving not less than eight hundred persons.

The outbreak showed the high incidence among women and children characteristic of milk borne typhoid, but was not explosive in type, and the mortality was somewhat higher than is usually experienced.

The origin of the infection was traced to a milker at the dairy who was shown to have a seminal vesiculitis due to B. typhosus, and was as a consequence excreting this organism in enormous numbers in his urine. The organism was never isolated from his stools.

Treatment of the vesiculitis by massage

and administration of urotropin greatly reduced the number of typhoid bacilli in the urine of the carrier, but did not wholly rid him of the infection. He remains a carrier.

The epidemic was brought to an end even before the detection and removal of the carrier, by ordinary commercial pasteurization of the milk.

Evidence is adduced of an unusually long incubation period in four cases of typhoid, three of which had their onset twenty-two days, and one twenty-seven days after the last raw milk was delivered.

REPORT OF THE COMMITTEE ON INDUSTRIAL HYGIENE

Read before the Conference of State and Provincial Health Authorities of North America, Lansing, Michigan, June 17, 1924.

THE Committee on Industrial Hygiene has been making annual reports for two or three years covering the relations of the subject to state and provincial health authorities, but thus far without evidence of progress or results. Perhaps an exception to this statement may be said to lie in the fact that its recognition as a proper function of this body has been recommended by the Committee and the scope of its field defined. (See Reports of previous years.—A.J.P.H., Oct., 1922, p. 839; Aug., 1923, p. 642.)

Believing that there is considerable uncertainty in the minds of many in regard to the nature of industrial hygiene and its claim for recognition at this time by this body and in view of the relative newness or recency of the field which it claims to cover, your Committee wishes to make several recommendations as follows:

(1) It is recommended that one or two tangible points in the field of industrial hygiene be attacked by members of the Conference in their respective states and provinces in order to establish factual data that may form a working basis for procedure in the future.

(2) It is recommended that, for the present, the end results only of faulty industrial hygiene be considered; viz., *Occupational Diseases.*

(3) While recognizing that several states and provinces now require the reporting of occupational diseases as a feature in "notifiable diseases," we believe that with the exception of half a dozen places, little is actually being done to secure data regarding them.

The Committee recommends that each state and province create a position, part-time or full-time as the situation would appear to warrant, or an office, bureau, or division of occupational diseases for the purpose of ascertaining, (a) the prevalence of occupational diseases, and (b) the correlation between morbidity and mortality statistics and occupations.

(4) It is recommended that in order to facilitate the duties of such office of service, each state and province, if it has not already done so, institute a regulation or secure the passage of a statute requiring the reporting of occupational diseases as separate and distinct items by all licensed physicians, the reports to be made to the state or provincial health authorities upon special certificates or blanks (preferably the so-called "standard form") to be devised by such authorities.

(5) In order to give appropriate publicity to this procedure, it is recommended that physicians and local health authorities be circularized in regard to the said regulation or statute and that there be sent to each licensed physician and health officer several such certificates or forms for reporting occupational diseases.

(6) It is recommended that annual reports upon a simple form approved by this Conference, which shall summarize the state and provincial statistics in regard to occupational diseases, be collected by state and provincial health officers for the purpose of their compilation by this Conference or such authority as it may designate.

JOHN E. MONGER, M.D., *Chairman.*